National Environmental Policy Act (NEPA)
ENVIRONMENTAL EVALUATION NOTIFICATION FORM

Grantee/Contractor Laboratory: BROOKHAVEN NATIONAL LABORATORY

Project/Activity Title: RSVP Experiments at AGS

CH NEPA Tracking No.: Type of Funding: National Science Foundation

B&R Code: Total ***Estimated*** Cost: $69M (KOPIO) plus $76M (MECO) FY03 Dollars

DOE Cognizant Secretarial Officer (CSO): James F. Decker, SC-1

Contractor Project Manager: T. Kirk Signature:

Date:

Contractor NEPA Reviewer: M. Davis Signature:

Date:

I. Description of Proposed Action:

This document briefly describes the accelerator modifications, new target systems and new detectors for the proposed experiments to be conducted under the Rare Symmetry Violating Processes (RSVP) contract.

The RSVP program consists of the MECO and KOPIO experiments. It is funded by the Major Research Equipment (MRE) initiative of the National Science Foundation. The RSVP Projects will be conducted in accord with a cooperative agreement between the National Science Foundation (NSF) and New York University (NYU), the RSVP grant-holding institution. These experiments will be performed at the BNL Alternating Gradient Synchrotron (AGS). As the host laboratory, BNL will oversee and support RSVP experiments.

It is noted that the MECO and KOPIO experiments are an approved class of experiments currently authorized by DOE for the AGS. Environmental, safety and health issues associated with this class of experiments have been documented in the AGS Safety Analysis Report[1] and the AGS Environmental Assessment[2].

MECO

The scientific objective of the MECO experiment is to detect an example of the process of a muon converting to an electron in the field of a nucleus if the rate for

[1] AGS Final Safety Analysis Report, AGS Department, Brookhaven National Laboratory, Associated Universities, Inc., Upton, New York 11973, February 27, 1991.
[2] Programmed Improvements Of The Alternating Gradient Synchrotron Complex At Brookhaven National Laboratory Upton, New York, Environmental Assessment, U. S. Department Of Energy, DOE/EA #0909, November 1993.

this process is as small as 2×10^{-17} times the rate for the process in which a muon is captured on a nucleus, changing the nuclear charge by one unit and emitting a neutrino. To date, no examples of a charged-lepton changing “flavor” have been observed, despite ever more sensitive searches being done since the 1940’s. If the process is discovered, it will be evidence for fundamentally new physics outside the current understanding of elementary particles and their interactions, as described by the Standard Model. The expected sensitivity of the MECO experiment is approximately 10,000 times that of current experiments, and represents a tremendous discovery potential.

AGS Accelerator Modification for MECO

The proton beam used to produce the required muon beam will be sufficiently intense such that the design sensitivity of the experiment can be achieved in a reasonable running time. The beam will be pulsed in order to allow detecting the conversion process without backgrounds from uninteresting physics processes. The required time structure will be achieved by exploiting the time structure in the circulating AGS beam, which is defined by the accelerating RF structure. The beam will be extracted while it is still captured in two RF buckets separated by half the circumference of the AGS, resulting in a pulse train separated by 1.35 μsec. The intensity required is 4×10^{13} protons (40 TP) to the experiment during each AGS cycle, with one cycle per second. Increased bunch intensity and techniques to extract a bunched beam at the required 8 GeV operating energy will be developed to meet these requirements. New magnet systems within the AGS will be installed and new operating techniques developed to ensure that protons circulate only in the desired RF buckets.

The planned initial running time for MECO is a total of 4000 hours; when this running time is completed, additional running may be requested and approved. Construction and engineering runs will occur in the years FY04 through FY09. Initial physics running will occur from FY10 through FY12. Total annual high-intensity running periods of 27 weeks will be shared with the KOPIO experiment.

A new AGS extraction line in Building 912 will be built for MECO. Tasks include removing existing equipment, refurbishing existing magnets and power supplies, and installing modified beam-line magnets, vacuum systems, beam-monitoring instruments, and shielding. These activities will not only allow the experiment to go forward, but they will have the added benefit of reducing radiation burden due to reduced beam losses and better shielding. A radio-frequency modulated magnet of new design will be developed to remove protons outside the desired pulses and allow monitoring of the performance of the AGS. Two new Lambertson magnets will be built and installed. A counter system will be built to measure the number of protons not in the desired pulses.

No new buildings or tunnels will be constructed for the MECO experiment. Existing accelerator components will be upgraded or replaced. Existing experimental areas in

Building 912 will be modified and used for the primary beam line, target area, beam stop and secondary beam line.

MECO Experiment in Building 912

A new proton target in the A line in Building 912 is required to produce the pions that will decay and produce the muon beam. The MECO target will either be a gold or platinum metal-target. The target will be cooled by water or perhaps gas. A 50-ton copper and tungsten shield will be built surrounding the target to protect the superconducting magnet, in which the target is installed, from the heat and radiation produced in the target. The shield will be supported off a cylindrical "strong-back" that will also serve as part of the vacuum vessel in which the muons are produced and transported.

A new, large bore, 5 T peak-field superconducting-magnet, which is the called the production solenoid, will be built to contain the pions and muons inside the shield and direct them into a magnetic transport region. A set of magnets consisting of sections of solenoids and toroids, which is called the transport solenoid, will be designed and built. The transport solenoid will serve to guide the beam of muons to the detector region in the evacuated bore of a new superconducting magnet, which is called the detector solenoid. The detector solenoid serves to capture electrons from the conversion process. The detector solenoid guides electrons to a region containing particle detectors that, together with the magnet, comprise a magnetic spectrometer.

Three collimators in the straight sections of the transport solenoid will serve to restrict passage to muons of the correct charge and momentum range. A thin beryllium window, situated in the second collimator, will absorb anti-protons.

Located in the detector solenoid are: the muon stopping target, the tracker, the calorimeter, the muon beam stop, and various absorbers. The stopping target consists of thin Al or Ti foils suspended by low-mass supports. Thin, low-Z cylinders and cones at large radii are required to shield the electron detectors from low-energy protons emitted by the stopping target following muon capture. Some of these are lithium-doped to absorb neutrons. A muon beam-stop is required to contain muons that have neither stopped in the target nor decayed.

Conversion electrons will be detected in a tracking detector installed in the constant field region of the detector solenoid. The tracker has roughly 3000 straws detectors, each about 2.6 m long and 5 mm in diameter, mounted approximately parallel to the axis of the detector solenoid; signals in these detectors will be used to determine the track coordinates. Capacitively-coupled strips attached to the planes of straw detectors will be used to measure the axial coordinate. Roughly 20000 readout channels will be required. The energy of electrons will be measured in a calorimeter downstream of the tracker.

The detector will be a high-density crystal detector arranged in four vanes similar to those of the tracker. Approximately 2000 crystals, each 3×3×12 cm, will be required. Crystal materials will either be GSO, BGO, or $PbWO_4$. Measuring the light output in a 1.0 T field necessitates the use of avalanche photodiodes. A total of 4000 channels of ADC readout will be required for the calorimeter.

A cosmic ray shield will be constructed out of iron to limit the background from cosmic ray muons interacting in the stopping target. It will consist of both passive shielding and an active scintillator-based veto detector. Long plastic-scintillator panels with wavelength shifter, based on existing designs, will be fabricated and installed.

A new enclosure for the front-end electronics will be built close to the experiment. An existing exterior building will be refurbished for use as the counting house. A data acquisition system and online computing facility will be assembled to record MECO data and allow for data quality-control. This will be supported by several workstations for data monitoring and tape handling hardware for data recording.

A sketch of the experimental layout in Building 912 is shown in Figures 1 and 2.

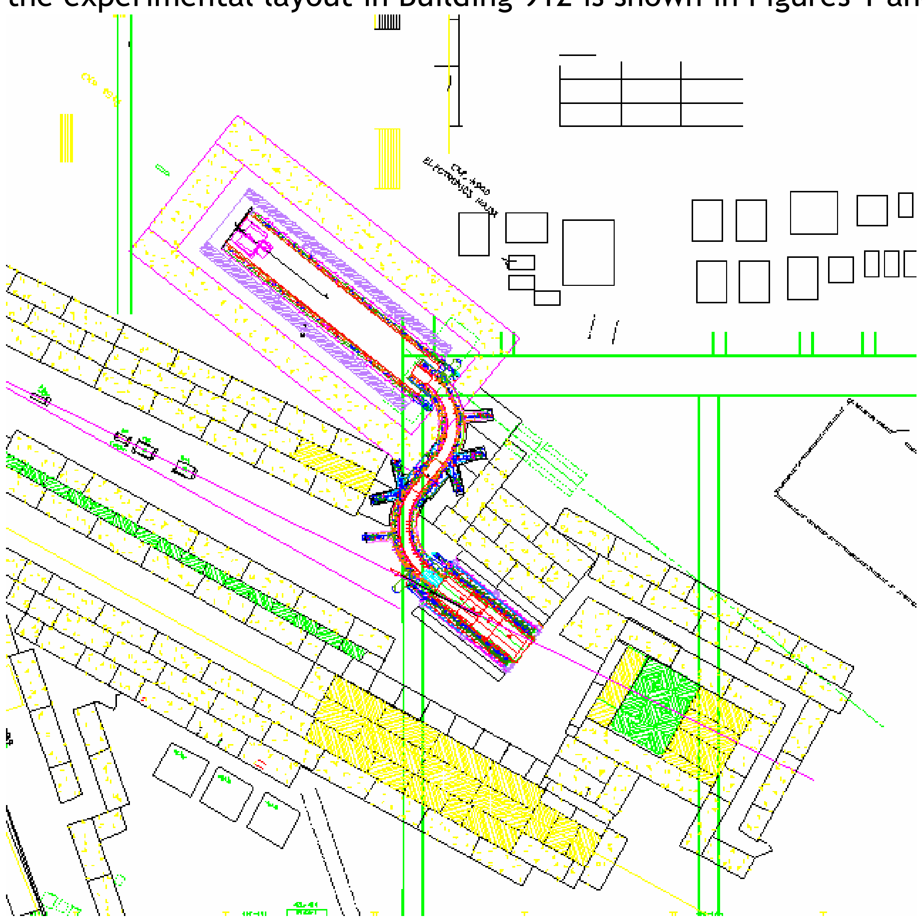

Figure 1. Proposed layout of the MECO experimental solenoids, target and shielding in the A Line in Building 912.

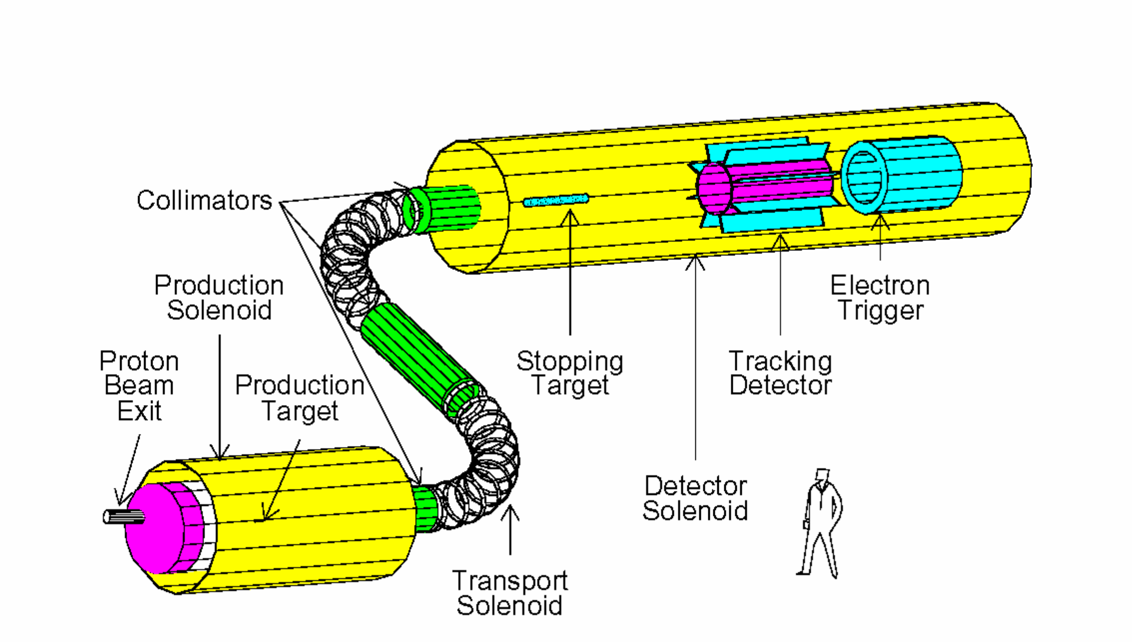

Figure 2. Relative Size of MECO Magnets and Solenoids

KOPIO

At the present time CP violation[3] is recognized to be one of the most important outstanding issues in the study of elementary particle physics. The KOPIO component of the RSVP project proposes a measurement of direct CP violation via the decay of a neutral kaon into a single neutral pion and a neutrino–antineutrino pair. The single most incisive measurement in the study of CP violation is that of the branching ratio for $K_L^0 \to \pi^0 \upsilon \overline{\upsilon}$. Using current estimates for Standard Model parameters, it is expected to lie in the range 2.8 $\times 10^{-11}$ +/- 1.0×10^{-11}.

The $K_L^0 \to \pi^0 \upsilon \overline{\upsilon}$ decay mode is unique, in that it is completely dominated by direct CP-violation and is entirely governed by short distance physics involving the top quark. Theoretical uncertainties are extremely small. Thus its measurement will provide the standard against which all other measurements of CP violation will be compared, and even small deviations from the expectation value derived from other Standard Model measurements will unambiguously signal the presence of new physics.

The KOPIO experiment in Building 912 will employ an intense low-energy, time structured secondary K_L^0 beam. This intense beam, with its special characteristics, will be provided via an intense proton beam extracted from the AGS. Building 912 will house the high-intensity proton beam extracted from AGS in a heavily-shielded transport-line. Building 912 will also house the proton-beam target area, the secondary neutral-kaon beam-line and the detector.

The high-intensity proton beam will be created by micro-bunching the AGS proton beam via two RF cavities.

AGS Accelerator Modification for KOPIO

For the KOPIO experiment, three upgrades to the AGS will be carried out by a

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[3] CP violation is the violation of the combined conservation laws associated with charge conjugation (C) and parity (P) by the weak nuclear force, which is responsible for reactions such as the decay of atomic nuclei. Charge conjugation is a mathematical operation that transforms a particle into an antiparticle, for example, changing the sign of the charge. Charge conjugation implies that every charged particle has an oppositely charged antimatter counterpart, or antiparticle. The antiparticle of an electrically neutral particle may be identical to the particle, as in the case of the neutral pion, or it may be distinct, as with the antineutron. Parity, or space inversion, is the reflection in the origin of the space coordinates of a particle or particle system; i.e., the three space dimensions x, y, and z become, respectively, -x, -y, and -z. Stated more concretely, parity conservation means that left and right and up and down are indistinguishable in the sense that an atomic nucleus throws off decay products up as often as down and left as often as right.

Kaons are unstable and are artificially spawned in K-antiK pairs amidst high energy collisions. Kaons are also made in conjunction with hyperons. Kaons are born courtesy of the strong nuclear force, but the rest of their short lives are under control of the weak force, which compels a sort of split personality: neither the K nor anti-K leads a life of its own. Instead each transforms repeatedly into the other. A more practical way of viewing the matter is to suppose that the K and anti-K are each a combination of two other particles, a short-lived entity called K_S which usually decays to two pions (giving K_S a CP value of +1) and a longer-lived entity, K_L, which decays into three pions (giving K_L a CP value of -1). This bit of bookkeeping enshrined the idea that CP is conserved.

collaboration of accelerator experts at BNL and TRIUMF: 1) extracting a micro-bunched proton beam, 2) increasing the proton intensity by a factor of 1.5 or more to 10^{14} protons (100 TP) per AGS cycle, and 3) modifying a primary proton beam-line in Building 912 to bring the intense micro-bunched beam to a new kaon production target. Part of this work involves upgrades to the Booster extraction kicker magnet and the AGS injection kicker magnet to deliver the increased kick strength required for proper 2.0 GeV operation of the Booster extraction/injection system.

After acceleration in the AGS, the primary proton beam required by KOPIO will be resonantly extracted at 25.5 GeV over 2.4 seconds with a micro-bunch structure of less than 300 ps rms. It is anticipated that the full AGS intensity of 10^{14} protons (100 TP) per AGS acceleration cycle of 4.7 seconds will be available.

The planned running time for KOPIO is a total of 8000 hours. Construction and engineering runs will occur in the years FY04 through FY09. Physics running will occur from FY10 through FY14. In FY 10, 11 and 12 high-intensity running periods of 27 weeks will be shared with the MECO experiment. In FY 13 and 14, KOPIO will run either alone or with MECO.

No new buildings or tunnels will be constructed for the KOPIO experiment. Existing accelerator components will be upgraded or replaced with similar components that exist in the AGS and Booster. Existing experimental areas in Building 912 will be modified and used for the KOPIO primary beam-line, target area, beam stop and secondary beam line.

<u>KOPIO Experiment in Building 912</u>

The micro-bunched beam extracted from AGS will be directed onto a B-line target to produce a neutral beam. The KOPIO target will be either a gold or a platinum metal target cooled by water. These types of targets have been used successfully for many years at AGS. After the target, the beam-line elements necessary to collimate a neutral beam will be present. This includes a sweeper magnet to remove converted gamma rays and charged particles from the beam before entry into the KOPIO detector, and shielding to reduce unwanted backgrounds produced by the primary proton beam.

The detector will consists primarily of a vacuum system, a pre-radiator, a calorimeter system and a charged particle and photon veto systems (see Figure 3). The vacuum will consist of a high-vacuum segment, which will contain the decay events of interest, and a low-vacuum system, which will minimize downstream interactions. The pre-radiator system will consist of 32 modules constructed of dual-coordinate drift chambers, scintillators, and layers of lead and copper. The pre-radiator will convert gamma rays and measure their directions. The calorimeter system will consist of lead-scintillator modules to measure energy. The photon veto will be a lead-scintillator sandwich that will be read out by wavelength-shifting fibers and phototubes. The charged particle veto will eliminate charged particles with very high efficiency, and the beam catcher will be a veto system used directly in the beam to detect and veto remaining photons.

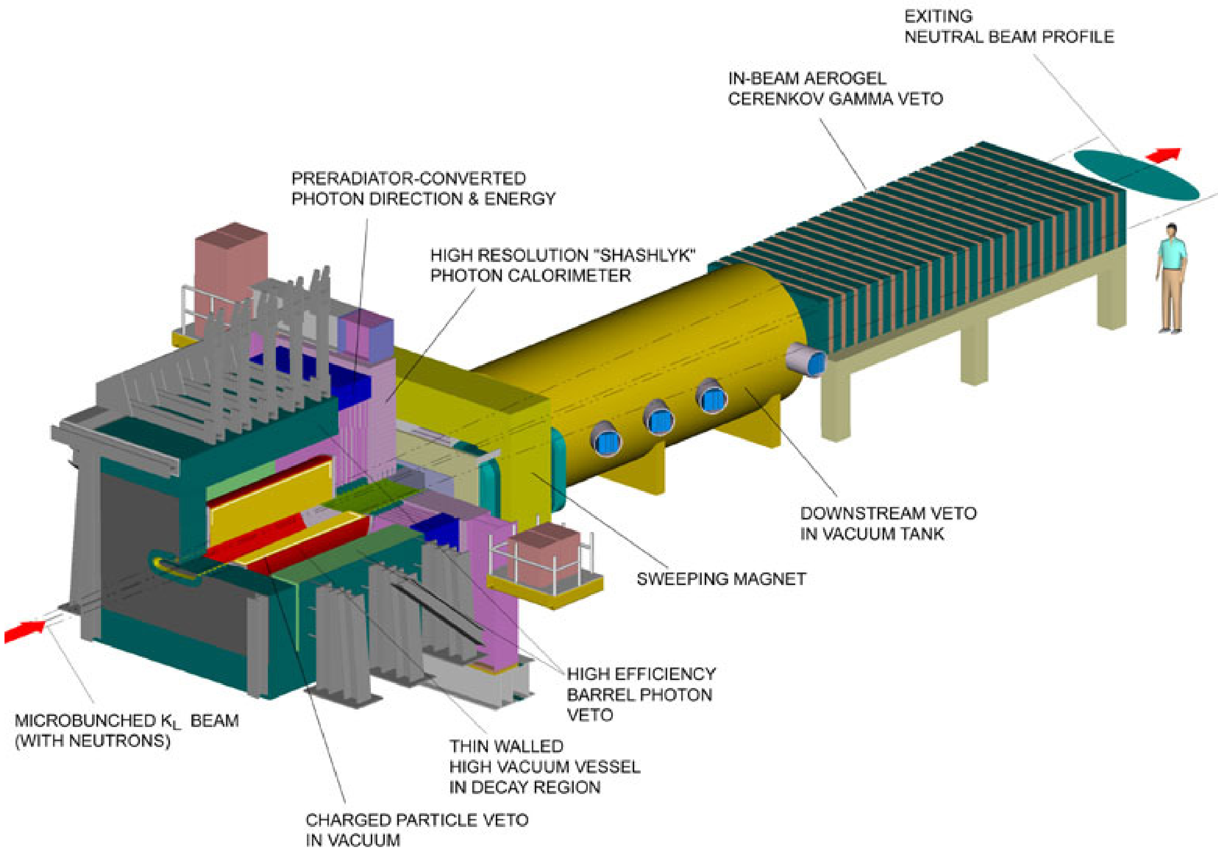

Figure 3. Relative Size of KOPIO Experimental Layout

<u>Common Issues for KOPIO and MECO Experiments</u>

Existing utilities and roads in and around Building 912 will be used. Existing power supply/utility buildings will be used. These buildings will house power distribution systems, power supplies, water pumping systems, instrumentation and controls for the MECO and KOPIO beam lines.

Electrical power is currently distributed around the site at 13.8 kV. Existing unit substations will transform the power into convenient voltages, typically 480 and 208/120 volts. Electrical power will be divided into two major categories: conventional and experimental. Conventional power will encompass building power for lighting and convenience power for heating, ventilation, air conditioning, and miscellaneous equipment. Although there are no safety critical power needs, emergency power will be provided as required for smooth operations. Experimental power will feed all the power supplies for magnets and associated equipment such as cooling-water pumps and cooling towers. All electric power distribution designs will follow the requirements of the National Electrical Code and industry standards.

The cooling water systems will use existing cooling towers for primary heat rejection. The cooling water systems for tritiated water lines will be isolated, closed-loop cooling systems with heat exchangers. All tritiated water systems will be in compliance with Suffolk County Article 12 requirements.

Groundwater monitoring wells will be provided to insure compliance with all Local, State and Federal groundwater protection requirements.

A shielded storage area will be provided for radioactive component storage and repair. Modular concrete and steel shielding will provide radiation shielding. Access to the proton target areas for installation and removal of the components will be accomplished by removing the modular shielding. The design of radiological areas will incorporate the as-low-as-reasonably-achievable (ALARA) radiation protection principles.

The un-interacted proton beams from KOPIO and MECO will exit to steel and concrete beam-stops, which will be located inside Building 912.

The soil beneath the target areas and beam-stop areas will be covered by Building 912. These activated soil areas will be protected by a building roof, and a concrete floor with a water-resistant lining. The water-resistant lining placed on the surface of the concrete floor over the target and beam-stop areas will add an additional barrier to further prevent water infiltration into these soil areas.

With the exception of lead layers in some scintillators, the detector assemblies for KOPIO and MECO will utilize non-hazardous material configurations such as plastic or glass-type scintillator detectors with steel as the absorber materials. MECO will have a small amount of lead based solder in the magnets, which will also be activated. The quantity of lead solder is small, well below 0.1% of mass of the magnet, and it is not considered to be a significant mixed waste issue.

The shielding policy for the KOPIO and MECO experiments will be the same as that for the rest of the Collider-Accelerator facilities. Specifically, the Collider-Accelerator Department's Radiation Safety Committee will review facility-shielding configurations to assure that the shielding has been designed to:

- Prevent contamination of the ground water
- Limit annual site-boundary dose equivalent to less than 5 mrem
- Limit annual on-site dose equivalent to inadvertently exposed people in non-Collider-Accelerator Department facilities to less than 25 mrem
- Limit dose equivalent to any area where access is not controlled to less than 20 mrem during a fault event

- Limit the dose equivalent rate to radiation-workers in continuously occupied locations to ALARA but in no case would it be greater than 0.5 mrem in one hour or 20 mrem in one week
- Limit the annual dose equivalent to radiation workers where occupancy is not continuous to ALARA, but in no case would it exceed 1000 mrem.

In addition to review and approval by the Radiation Safety Committee, final shield drawings will be approved by the Radiation Safety Committee Chair or the C-AD ESHQ Associate Chair. Shield drawings will be verified by comparing the drawing to the actual configuration. Radiation surveys and fault studies will be conducted after the shield has been constructed in order to verify the adequacy of the shield configuration. The fault study methodology that will be used to verify the adequacy of shielding is proscribed and controlled by Collider-Accelerator Department procedures.

II. Description of Affected Environment:

All activities associated with the proposed action will take place inside currently operating accelerator and experimental facilities. The effected area is outside the half-mile permit-corridor surrounding the Peconic River. Since BNL is situated over a sole source aquifer, extensive engineering, design, monitoring and administrative efforts will be taken to prevent adversely impacting the groundwater. Overall, the proposed action is not expected to adversely impact the environment.

AGS Environmental Assessment (EA) #0909 addressed operations of the AGS and its associated fixed target experimental areas for the conditions of 33 GeV, $6x10^{13}$ protons every 3 seconds (20 TP/s) and 20 weeks per year. In the case of the MECO experiment, the energy of the proton beam will decrease from 33 to 8 GeV but the intensity will increase from 20 TP/s to 40 TP/s. The MECO running period will increase to 17 weeks per year maximum in FY12. Based on adjustments to energy, beam intensity and running period, the impact of MECO in any given year on the dose estimates in AGS EA #0909 is a reduction. That is, the maximum MECO running period (FY12) results in 55% of the radiological impacts described in AGS EA #0909. The effect of reduced energy on dose reduction is taken as $E^{0.8}$. In the case of the KOPIO experiment, the intensity is 100 TP every 4.7 seconds or 21 TP/s. The proton energy is 25.5 GeV. If the running period is 10 weeks in the year that MECO's running period is 17 weeks, then the impact of KOPIO running is 41% of the dose estimates in AGS #0909. Thus, the running of these two experiments in any given year does not significantly alter the conclusions reached in AGS EA #0909.

AGS EA #0909 indicated the AGS facilities annually generate approximately 1,520 cubic meters of compressed garbage, 760 cubic meters of construction debris, 72 cubic meters of low level radioactive waste, and 5 cubic meters of other hazardous wastes mainly in the form of used oils such as vacuum pump oil. There will be no increase in these rates due to KOPIO and MECO operations.

It is noted the above comparison to AGS EA #0909 results does not include the likely dose reductions and radioactive-waste reductions that will result from improvements in component reliability, beam control and shielding. Since the early 1970s the major portion of the AGS radiation burden has been associated with equipment failures and maintenance. Substantial effort and expense have been committed to improving the operational reliability and serviceability of beam-line components and this continues to be effective in reducing the radiation burden. In 1973, when protons were accelerated at an intensity of 1 TP, maintenance workers and experimenters incurred 575 person-rem from working on equipment. As indicated in AGS EA #0909, radiation exposures experienced by maintenance workers and experimenters was anticipated to be reduced to 10 to 15 person-rem per year due to increased operational reliability, even though intensity increased in AGS EA #0909 to 60 TP. This, in fact, was the experience at AGS throughout the 1990s and 2000. As KOPIO and MECO come on line, continued improvements to the operational reliability and serviceability of beam-line components is anticipated, which we feel will further reduce radiation burden.

III. Potential Environmental Effects: (Attach explanation for each "yes" response and "no" response if additional information is available and could be significant in the decision making process.)

A. Sensitive Resources: Will the proposed action result in changes and/or disturbances to any of the following resources?

		Yes/No
1.	Threatened/Endangered Species and/or Critical Habitats	No
2.	Other Protected Species (e.g., Burros, Migratory Birds)	No
3.	Wetlands	No
4.	Archaeological/Historic Resources	No
5.	Prime, Unique or Important Farmland	No
6.	Non-Attainment Areas	No
7.	Class I Air Quality Control Region	No
8.	Special Sources of Groundwater (e.g., Sole Source Aquifer)	Yes
9.	Navigable Air Space	No
10.	Coastal Zones (e.g., National Forests, Parks, Trails)	
11.	Areas w/Special National Designation (e.g., National Forests, Parks, Trails)	No
12.	Floodplain	No

B. Regulated Substances/Activities: Will the proposed action involve any of the following regulated substances or activities?

		Yes/No
13.	Clearing or Excavation (indicate if greater than 5 acres)	No
14.	Dredge or Fill (under Clean Water Act section 404; indicate if greater than 10 acres)	No
15.	Noise (in excess of regulations)	No
16.	Asbestos Removal	No
17.	PCBs	No
18.	Import, Manufacture or Processing of Toxic Substances	No
19.	Chemical Storage/Use	Yes
20.	Pesticide Use	No
21.	Hazardous, Toxic, or Criteria Pollutant Air Emissions	No
22.	Liquid Effluent	Yes
23.	Underground Injection	No
24.	Hazardous Waste	Yes

25.	Underground Storage Tanks	No
26.	Radioactive (AEA) Mixed Waste	No
27.	Radioactive Waste	Yes
28.	Radiation Exposures	Yes

C. Other Relevant Disclosures. Will the proposed action involve the following?
Yes/No

29.	A threatened violation of ES&H regulations/permit requirements	No
30.	Siting/Construction/Major Modification of Waste Recovery or TSD Facilities	No
31.	Disturbance of Pre-existing Contamination	No
32.	New or Modified Federal/State Permits	Yes
33.	Public controversy (e.g., Environmental Justice Executive Order 12898 consideration and other related public issues)	No
34.	Action/involvement of Another Federal Agency (e.g., license, funding, approval)	Yes
35.	Action of a State Agency in a State with NEPA-type law. (Does the State Environmental Quality Review Act Apply?)	No
36.	Public Utilities/Services	No
37.	Depletion of a Non-Renewable Resource	Yes

IV. Section D Determination: Is the project/activity appropriate for a determination by the OM under Subpart D of the DOE NEPA Regulations for compliance with NEPA?

A. DOE-CH NEPA Coordinator Review:

DOE-CH NEPA Coordinator Reviewer: ________________________

Signature: ________________________ Date: ________________

B. DOE CH NCO NEPA Review:

NCO Concurrence with Proposed Class of Action Recommended

CX EA EIS

Category ________________________

DOE CH NCO Reviewer: ________________________

Signature: ________________________ Date: ________________

DOE Recommendation Approvals:

CH NCO: ________________________ Signature: ________________________

Date: ________________________

CH GLD: ________________________ Signature: ________________________

Date: ________________________

CH ESHD: ______________________________ Signature:_________________________

Date:_________________________

CH AMST: ______________________________ Signature:_________________________

Date:_________________________

CH Office Mgr.: ________________________ Signature:_________________________

Date:_________________________

V. Additional Information

A8 Although BNL is situated over a Sole Source Aquifer, operation of these accelerator facilities and experiments should not affect the aquifer. This would include discharges to the BNL sanitary and storm water systems. The BNL Standards Based Management System Subject Area "Liquid Effluents" provides requirements related to discharges. Work planning, experimental review, and Tier I safety inspections are three examples of several methods used to ensure hazardous effluents will not make their way into the sanitary waste-stream or storm-water discharges.

B19 Routine operation and maintenance actions associated with the accelerator facilities and experiments will involve the use of chemicals or compounds, generally in small quantities. BNL's Chemical Management System will track the quantity, location, owner and storage of any chemical inventory.

B22 Any discharges associated with the proposed action, including cooling-tower effluent, will be managed according to the BNL Standards Based Management System Subject Area "Liquid Effluents".

B24 Routine operation and maintenance actions associated with the accelerator facilities will result in a small amount of hazardous wastes being generated, primarily cleaning compounds. The total volume generated would not be expected to exceed a fraction of a cubic meter per year and will not constitute a significant increase to Collider-Accelerator Department total estimates. All hazardous wastes will be managed in accordance with established BNL procedures and subject areas. Work planning, experimental review, and Tier I safety inspections are three examples of several methods for ensuring wastes are minimized and controlled.

B27 Routine operation and maintenance actions associated with the AGS and KOPIO and MECO experiments will result in a moderate amount of radioactive waste being generated each year. The total volume generated will not be expected to exceed a few cubic meters per year and will not constitute a significant increase to present-day Collider-Accelerator Department (C-AD) radioactive-waste output. It is estimated that following FY14, D&D work on the KOPIO and MECO experimental areas will result in the current-level of total C-AD radioactive waste will continue for about three more years longer than currently planned. It is understood that a separate fund will be established by NSF and accumulated by DOE in FY04 through FY14 in order to pay for these radioactive wastes in the future (70 cubic meters each year for three years). All radioactive wastes will be managed in accordance with established BNL procedures and subject areas. Work planning, experimental review, and Tier I safety inspections are three examples of present-day methods for ensuring future wastes will be minimized and controlled.

B28 Routine operation and maintenance actions associated with the accelerator facilities will result in low-level radiation exposures to workers. Shielding designs, Interlocks, access controls, training and procedure administration will be used to minimize exposures and employ ALARA principles.

C32 Depending on the disposition of the cooling-tower's discharge, the existing New York State Pollutant Discharge Elimination System (SPDES) permit will be revised as necessary. The proposed contact-cooling systems will be closed-loop de-ionized water systems using ion exchange beds that will be removed for disposal off-site. At the proposed beam intensities and energies, induced activity will be expected in the cooling water used in closed-looped systems. This water will be collected and handled according to currently DOE-approved waste practices. Discharge of radioactive water or contaminants to the ground or to the sanitary system are not planned nor expected from these cooling systems. These closed-loop cooling systems will be connected to cooling towers via a heat exchanger. Cooling-tower waters will be treated either with ozone or with biocides and rust inhibitors, and would meet all SPDES effluent limits.

Instead of water, if nitrogen or helium is used to cool the MECO target, then a radioactive air-emission may result. Nitrogen from the MECO heat shield cooling system will also be slightly activated, as well as slightly activated helium which will be vented occasionally. Emissions will be short lived with 10 to 20 minute half-lives, and a NESHAPS evaluation will be performed. The total airborne emission is expected to be much much less than the NESHAPS level for continuous monitoring (<< 0.1 mrem per year).

C34 The Rare Symmetry Violating Processes (RSVP) program is funded by the Major Research Equipment (MRE) initiative of the National Science Foundation. The RSVP projects will be conducted in accordance with a cooperative agreement between the National Science Foundation (NSF) and New York University (NYU), the RSVP grant-holding institution and through a memorandum of understanding and subcontract between NYU and the University of California, Irvine (UCI), in the case of MECO, and through a memorandum of understanding and subcontract between NYU and the State University of New York, in the case of KOPIO. UCI and Stony Brook are the lead financial institutions for MECO and KOPIO, respectively.

The NSF is responsible for providing funding, general oversight, monitoring, and evaluation to help assure the projects' success. BNL has many roles: the host laboratory where the experiments will be installed and operated, a collaborative role in each experiment, an oversight role by the Associate Laboratory Director for High Energy and Nuclear Physics (ALD), and a support role, providing NSF supported technical manpower to the projects. NYU, as the grant-holding institution, is party to the cooperative agreement by which the projects are operated and accepts and disburses funds to MECO and KOPIO under the terms of the agreement. NYU is responsible for ensuring that the projects are operated according to general NSF guidelines and specific guidelines in the agreement. Stony Brook and UCI will receive funds from NYU and disburse them to their respective project's collaborating institutions. The collaborating institutions will accept responsibility for and receive funds for their respective project's deliverables. The collaborations have established rules for their governance and each of the projects has a management structure that aids the smooth operation of that project.

C37 The day-to-day release of helium from the MECO experiment will be very small, virtually negligible. The potential issue is release of large quantities such as 5000 liters liquid helium (3800 cubic meters gas) in the event of a magnet quench. We have concluded that this is a cost-effective way to operate, cheaper than trying to build a gas recovery system. These magnets should not quench, but probably will a few times during the lifetime of the experiment. The helium would not be released during normal shutdown. Helium is a constituent of natural gas deposits ranging from a trace to about 8 percent by volume. Helium is also a minor constituent (0.0005 %) of the atmosphere. Most natural gas is burned as fuel without first recovering the helium. Consequently, much helium is lost to the atmosphere and diluted beyond effective recovery. The helium resources of the United States are estimated to be about 13 billion cubic meters (470 billion cubic feet). World helium resources exclusive of the United States are estimated at 18 billion cubic meters (650 billion cubic feet) of which 9.2 billion cubic meters are in the former Soviet Union, mostly in Russia. Other helium resources are located in Algeria, 2.1 billion cubic meters; Canada, 2.1 billion cubic meters; China, 1.1 billion cubic meters; Poland, 0.8 billion cubic meters; and the Netherlands, 0.7 billion cubic meters.[4] It is concluded that several quenches during the lifetime of the MECO experiment would not significantly accelerate exhaustion of the resource.

4 See http://www.ncseonline.org/NLE/CRSreports/Natural/nrgen-11.cfm?&CFID=12047927&CFTOKEN=65169140